Citation:

Mirmiran P, Noori N, Zavareh MB, Azizi F. Fruit and vegetable consumption and risk factors for cardiovascular disease. *Metabolism*. 2009 Apr; 58 (4): 460-468.

PubMed ID: 19303965

Study Design:

Cross-Sectional Study

Class:

D - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

⊕ POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To evaluate whether higher intakes of fruit and vegetables could be inversely related to cardiovascular disease (CVD) risk factors.

Inclusion Criteria:

Aged 18 to 74 years.

Exclusion Criteria:

Subjects whose reported daily intakes were outside of the range of 800 to 4,200kcal per day.

Description of Study Protocol:

Recruitment

The current study was part of a prospective study (Tehran Lipid and Glucose Study) of a representative sample of residents of district 13 of Tehran, Iran.

Design

Cross-sectional study.

Dietary Intake/Dietary Assessment Methodology

A food-frequency questionnaire (FFQ) was administered by trained dieticians and measured the frequency of consumption for each food item during the previous year.

Blinding Used

Not applicable.

Intervention

Not applicable.

Statistical Analysis

- Subjects were categorized based on frequency of fruit and vegetable consumption per day (zero to 1.9; 2 to 2.9; 3 to 3.9; and at least four)
- A general linear model was used to estimate adjusted mean concentrations of cardiovascular risk factors across categories of fruit and vegetable intakes
- Adjusted multivariable regression was used to assess the association between fruit and vegetable intake with cardiovascular risks
- The Keys score, which correlated changes in fatty acid intake with changes in serum cholesterol, was also calculated and used in the study analysis.

Data Collection Summary:

Timing of Measurements

All variables measured at one time-point (cross-sectional study).

Dependent Variables

- Cardiovascular risk factors
    - High total cholesterol ($\geq$240mg/dL)
    - High serum LDL-C (>130mg/dL)
    - Low serum HDL-C (<40mg/dL or men and <50mg/dL for women)
    - High serum triglyceride concentration ($\geq$200mg/dL)
    - Elevated systolic ($\geq$140mmHg) or diastolic ($\geq$90 mmHg) (SBP or DBP) blood pressure
    - Abnormal glucose homeostasis (fasting plasma glucose concentration $\geq$110mg/dL)
    - High body mass index (BMI) (>30kg/m^2).

Independent Variables

Categorized daily fruit and vegetable intake measure by a FFQ (zero to 1.9; 2 to 2.9; 3 to 3.9; and at least four servings per day).

Control Variables

- Physical activity level
- Age
- Sex
- Keys score
- BMI
- Energy intake
- Smoking status
- Dietary cholesterol
- History of coronary artery disease
- Diabetes mellitus
- Education
- Total dietary fat

- Saturated fat
- Polyunsaturated fat.

Description of Actual Data Sample:

- *Initial N:* 861 (before applying exclusion criteria)
- *Attrition (final N):* 840
    - 361 men
    - 479 women
- *Age:* 18 to 74 years (mean of 37.2 years)
- *Ethnicity:* Not reported
- *Other relevant demographics:* Urban population
- *Anthropometrics:* None
- *Location:* Tehran, Iran.

Summary of Results:

Key findings

- In multivariate analyses, subjects in the upper category of fruit and vegetable intake had lower total cholesterol, LDL-C, total cholesterol to HDL-C, and LDL-C / HDL-C as compared with those in the lower category. No significant differences were seen between triglycerides, fasting plasma glucose, HDL-C, and blood pressure for participants in category 1 and those in category 4 of fruit and vegetable intake
- Multivariate-adjusted odds ratios for high LDL-C concentrations across fruit and vegetable intake (1 to 4) were 0.88, 0.81 and 0.75 (P for trend <0.01).

Author Conclusion:

Consumption of fruits and vegetables is inversely related to total cholesterol and LDL-C concentrations.

Reviewer Comments:

Study strengths

- *Population-based sample, representative of Tehran, Iran*
- *Exclusion of participants with prevalent CVD and diabetes mellitus did not alter results significantly*
- *Adjusted for many covariates in multivariate models.*

Study limitations

- *Fruit and vegetable consumption was self-reported*
- *Models did not adjust for family history of CVD.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)		Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?		Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?		Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)		Yes

Validity Questions

1.	**Was the research question clearly stated?**		Yes
	1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
	1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
	1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**		Yes
	2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
	2.2.	Were criteria applied equally to all study groups?	N/A
	2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
	2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**		Yes
	3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
	3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
	3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A

3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	N/A
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	No
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	N/A
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes

6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?		Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?		Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?		N/A
6.6.	Were extra or unplanned treatments described?		N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?		N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?		N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**		Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?		Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?		Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?		N/A
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?		Yes
7.5.	Was the measurement of effect at an appropriate level of precision?		Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?		Yes
7.7.	Were the measurements conducted consistently across groups?		N/A
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**		Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?		Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?		Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?		Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?		N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?		Yes
8.6.	Was clinical significance as well as statistical significance reported?		No

8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes